Louis de Broglie. An introduction to the study of wave mechanics. 246 pages and 14 diagrams. Translation by H.T. Flint, D.Sc., Ph.D. Edition of E.P. Dutton and Co. Inc., New York.

The author is a professor in the Henri Poincaré Institute in Paris. He is the winner of the Nobel prize for Physics for 1929. The revised book contains an exposition of a new dynamical theory by one of its originators.

There are recognized at present two kinds of motion: That of a particle and wave motion. The famous question about the light propogation was discussed for centuries. Newton held the view, that light is a motion of material particles, but it was until recently almost universally accepted that light is a vibratory movement of ~~ether~~. With the experiments of Michelson-Morley ~~[illegible]~~ and of other physicists, and with the appearance of the theory of Relativity, the old notion of ether was shaken to its foundation and new conceptions of space and dynamics were developed. In order to satisfy the new physical data and the famous Plank's theory of black body radiation, it appeared to be necessary to return to the Newtonian understanding of light propogation, as a stream of particles, accepted in the new theory as photons. The discovery of the photo-electric effect, confirmed by the Compton effect, showed, that the idea of a granular structure of light must be introduced into optics, while the phenomena of diffraction and interference insisted on the conservation of the concept of waves. Thus, light cannot be discribed as a motion of simple particles and Physics faces a curious dualism of motion. The A. has undertaken in this book to show, that mathematicalley the both theories can be reconciled. He studies here the phenomena of associated wave where is no interaction between particles, the phenomena of a train of particles acting one upon another and the movement of a single particle through a generalized space. The A. accepts as a well established principle, that the square of the amplitude of the wave, i.e. its intensity, must measure the probability of localisation of the associated particle for each point of space and at each instant of time. The logic consequence of this ~~principle~~ postulate is, ~~that it~~ this principle is ~~must are~~ necessary to account for the phenomena of interference and diffraction of light, for the maximum of luminous energy is found in the places of the Fresnel wave's greatest intensity. The phenomena of interference and diffraction are not uncompatible with the corpuscular theory, ~~at the same time~~ and the formulae of the associated and single waves in various media are in agreement with the equations of the moving particle. The A. thus establishes a parallelism between the old mechanics and the propogation of the light waves proceeding according to the laws of geometrical optics. The corpuscular theory of light receives a new confirmation. But the difficulty arises, when we try to represent physically the motion of a particle. We can imagine a a cloud of particles discribing all paths, which correspond to one and the same function of Jacobi, in which case the density of the cloud can be measured by the intensity of the associated wave. The trajectory of an imaginary particle here can be represented as the wave-train since in the total motion of the particles of the cloud, the position of a single one will coincide ~~fat~~ each instant of time with that predicted mathematically. It is more difficult to understand the trajectory of a single particle in cases where the conditions of geometrical optics do not prevail. There are several theories to explain its trajectory, but non of them is entirely satisfactory. Schrödinger thinks, that a single particle should be regarded as a „wave-packet", constituted by a group of waves of neighbouring frequencies which obeys the laws of geometrical optics. But, according to this theory an electron diffracted by a crystal should be completely dispersed and destroyed and no particle would have a stable existence. This theory is not confirmed by the experiments and cannot be generalized. There is another theory of the pilot-wave. Since the motion of the particle agrees with the propagation of the wave it may be supposed, that the particle is guided by the wave, or, according to a modification of this view by Kennard, instead of speaking of the actual trajectory, we can speak of the trajectory of the „elements of probability". But there are several objections to this theory, the main of which is this: the experiments with a mirror cannot agree with the assumption, that the wave is a physical phenomenon, and if the wave is a symbolical representation of a probability it is difficult to understand the guidance of the particle by the wave. There is also neither conservation of energy, nor of momentum for the probability elements even in the absence of a field. There are other serious considerations against the pilot-wave theory. The most favoured view at present is that of Bohr and Heisenberg. According to it the wave does not represent a physical phenomenon, but is simply a symbolic representation of our knowledge of the moving particle. No experiment can show exactly the actual position of the particle or its particular velocity. The experiment shows only a probability of the position and the velocity within certain limits. Consequently, there is no longer a rigorous determinism in Nature, but only laws of probability. This assumption introduces new conceptions of physics, where the wave has non-physical character and the particle cannot be portrayed as a very small object, having position in space, a velocity and a trajectory. In other words, physical phenomena according to Bohr have not clear, definite meanings accepted by the mechanics. Einstein pointed out two possible attitudes: the first consists of retaining the idea of the particle localized at each instance in space. But a natural law expressed by Heisenberg's relations does not permit to determine exactly the position and state of motion of the particle. The undeterminism of Bohr and Heisenberg must be regarded only as an uncertainty within definite limits. The second attitude accepts the view, that the particle associated with an extended wave-train is not actually localized in space and time, but in a certain sense is present throughout the extent of the wave-train, and by some unknown cause it is condensed at a definite point to produce an observable effect. The interpretation of the dualism of waves and particles contains many difficulties, especially in the question of localisation of the particle on the wave, and the A. thinks, that a satisfactory solution will be reached probably by the introduction of some new idea into the present notions of the Space-Time frame. The work of de Broglie is very interesting because it shows that, there is no fundamental difference between the wave propagation and the motion of a particle, but even more so because at the same time he pointed out the difficulties arising from the actual conception of ~~the~~ displacement of a particle. We think, that there is no actual means to observe directly a motion of a body in space, because the observer receives throughout the motion continuously new light waves bombarding his retina and thus he sees in every new place practically a another body. Then, the body in motion is a cloud of moving particles and it suffers continous molecular and intra-atomic changes, so that the body is in every new place different from that in the previous place. We may ask, whether a single particle in every instant of its motion remains the very same particle, or it is a newly originated particle very similar to the previous one? The question cannot be answered until a new conception of space and Matter will be introduced. The classical Physics tacitly accepted the existence of a homogeneous space as a sort of the container of Matter. The theory of Relativity showed that this is only a particular case in a series of different possible spaces. This theory studied the qualities of space still separating the conception of it from that of Matter. The physical motion may be characterized as a certain change in Space-time. Therefore, to study the nature of motion we must study the nature of Space. The Relativity theory states, that the field of force produces certain qualities of the corresponding space. ~~Now~~ Then, the total energy of a particle is creating a particular space within the particle, which is most intimately related to the physical properties of the particle. In every new place it meets a new spacial condition and the very fact of the displacement means a certain change of the particle. Therefore, we cannot regard a "displaced" particle as identical with the previous one, but only as analogous. Its energy, being intimately related to the space-value, cannot be separated from space and probably should be regarded as a condensation of the particular space. Thus, a moving particle will in fact represent a continous, consecutive generation of new particles along the trajectory not unsimilar to the consecutive raising of particles of a liquid forming a wave. The length of a motion-wave will correspond to the distance between ~~the~~ positions of of the two consecutively generating particles, and the amplitude - to the intensity, which in this case will be the intensity of condensation of space. It is probable, that this conception of motion, which agrees apparently with wave propogation and mechanical movement theories, and permits to localize the particle on the definite trajectory, will bring some clearness into the question under discussion. It will be then necessary to study Space as a medium genărating matter with its mathematical conditions of condensation. Space will thus become a real cosmic Tension and matter - its function. De Broglie has touched in the present book an exceedingly interesting point, which will probably lead to an entire reconstruction of our notions of space and ~~physi~~ dynamics.

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The discovery of the photo-electric effect confirmed by the Compton effect, showed that the idea of granular structure of light must be introduced into optics, while the phenomena of diffraction and interference insisted on the conservation of the concept of waves. This light cannot be described as a motion of simple particles and physics faces a curious dualism of motion. The author has undertaken in this book to show that mathematically both theories can be reconciled He studies here the phenomena of associated waves, where is no interaction between particles, the phenomena of a train of particles acting one upon another and the movement of a single particle through a generalized space. The author accepts as a well established principle that the square of the amplitude of the wave, i.e. its intensity, must measure the probability of localisation of the associated particle for each point of space and at each instant of time. The logical consequence of this postulate is that this principle is necessary to account for the phenomena of interference and diffraction of light, for the maximum of luminous energy is found in the places of the Fresnel wave's greatest intensity. The phenomena of interference and diffraction are not uncompatible with the corpuscular theory and the formulae of the associated and single waves in various media are in agreement with the equations of the moving particle. The author thus establishes a parallelism between the old mechanics and the propagation of the light waves proceeding according to the laws of geometric optics. The corpuscular theory of light receives a new confirmation. But the difficulty arises, when we try to represent physically the motion of a particle. We can imagine a cloud of particles describing all paths, which correspond to one and the same function of Jacobi, in which case the density of the cloud can be measured by the intensity of the associated wave. 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